



General

Guideline Title

ACR Appropriateness Criteria® postmastectomy radiotherapy.

Bibliographic Source(s)

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Guideline Status

This is the current release of the guideline.

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Recommendations

Major Recommendations

ACR Appropriateness Criteria®

Clinical Condition: Postmastectomy Radiotherapy

Variant 1: 50-year-old woman, infiltrating ductal carcinoma, status post (S/P) modified radical mastectomy, 1.5 cm upper outer quadrant (UOQ), margins (-), 4/15 LNs (+). No blood vessel invasion or lymphovascular invasion (LVI), no metastasis, systemic treatment planned (type undecided). ER/PR (+), HER2 not overexpressed.

Treatment	Rating	Comments
Principles of Treatment (Volumes)		
Chest wall RT	9	
Supraclavicular fossa/level III axilla RT	9	
Supraclavicular fossa and level I-III axilla RT	3	

Treatment	Rating	Comments
Internal mammary node RT	7	
Central chest wall boost	8	Boost may be appropriate, as indicated by risk of residual microscopic disease relative to the radiation dose achieved with comprehensive chest wall irradiation.
Chest Wall RT Doses		
50-50.4 Gy in 25-28 fractions	9	
37.5-42.5 Gy in 16 fractions	6	In selected cases may be appropriate.
Supraclavicular Fossa/Axillary RT Doses		
45-50.4 Gy in 25-28 fractions	9	
37.5 Gy in 16 fractions	3	
IMN Chain RT Doses (if treating)		
50-50.4 Gy in 25-28 fractions	9	
37.5-42.5 Gy in 16 fractions	3	
Chest Wall Boost RT Doses (if treating)		
10 Gy in 5 fractions	9	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Note: Abbreviations used in the table are listed at the end of the "Major Recommendations" field.

Variant 2: 50-year-old postmenopausal woman, infiltrating ductal carcinoma, S/P modified radical mastectomy, 6.5 cm UOQ, margins (-), 2/15 LNs (+), ER/PR (+), HER2 (-). No blood vessel invasion or LVI, no metastasis, systemic treatment planned (type undecided).

Treatment	Rating	Comments
Principles of Treatment (Volumes)		
Chest wall RT	9	
Supraclavicular fossa/level III axilla RT	9	
Supraclavicular fossa and level I-III axilla RT	3	
Internal mammary node RT	8	
Central chest wall boost	8	Boost may be appropriate, as indicated by risk of residual microscopic disease relative to the radiation dose achieved with comprehensive chest wall irradiation.
Chest Wall RT Doses		
50-50.4 Gy in 25-28 fractions	9	
37.5-42.5 Gy in 16 fractions	6	In selected cases may be appropriate.
Supraclavicular Fossa/Axillary RT Doses		
45-50.4 Gy in 25-28 fractions	9	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Treatment	Rating	Comments
IMN Chain RT Doses (if treating)		
50-50.4 Gy in 25-28 fractions	9	
37.5-42.5 Gy in 16 fractions	3	
Chest Wall Boost RT Doses (if treating)		
10 Gy in 5 fractions	9	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Note: Abbreviations used in the table are listed at the end of the "Major Recommendations" field.

Variant 3: 54-year-old postmenopausal woman, infiltrating ductal carcinoma, S/P modified radical mastectomy, 1.5 cm UOQ, margins (-), 2/15 LNs (+), ER/PR (+), HER2 (-). No blood vessel invasion or LVI, no metastasis, systemic treatment planned (type undecided).

Treatment	Rating	Comments
Principles of Treatment (Volumes)		
Chest wall RT	7	
Supraclavicular fossa/level III axilla RT	7	
Supraclavicular fossa and level I-III axilla RT	3	
Internal mammary node RT	7	
Central chest wall boost	7	Boost may be appropriate, as indicated by risk of residual microscopic disease relative to the radiation dose achieved with comprehensive chest wall irradiation.
Chest Wall RT Doses		
50-50.4 Gy in 25-28 fractions	9	
37.5-42.5 Gy in 16 fractions	6	In selected cases may be appropriate.
Supraclavicular Fossa/Axillary RT Doses		
45-50.4 Gy in 25-28 fractions	9	
37.5-42.5 Gy in 16 fractions	3	
IMN Chain RT Doses (if treating)		
50-50.4 Gy in 25-28 fractions	9	
37.5-42.5 Gy in 16 fractions	3	
Chest Wall Boost RT Doses (if treating)		
10 Gy in 5 fractions	9	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Note: Abbreviations used in the table are listed at the end of the "Major Recommendations" field.

Variant 4: 40-year-old woman, S/P mastectomy and sentinel node biopsy for multifocal invasive breast cancer, no focus greater than 1.0 cm. Sentinel node frozen section was negative, but the permanent section shows a focus of metastasis (<2 mm). Completion level I/II axillary dissection demonstrates no further tumor in nine lymph nodes. Cytotoxic chemotherapy is planned. ER/PR (–), immunohistochemistry only (+).

Treatment	Rating	Comments
Principles of Treatment (Volumes)		
Chest wall RT	1	
Supraclavicular fossa/level III axilla RT	1	
Supraclavicular fossa and level I-III axilla RT	1	
Internal mammary node RT	1	
Central chest wall boost	1	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Note: Abbreviations used in the table are listed at the end of the "Major Recommendations" field.

Variant 5: 50-year-old woman, grade 3 infiltrating ductal carcinoma, S/P modified radical mastectomy, tumor is 3.5 cm UOQ, margins (–), 0/15 LNs (+). No blood vessel invasion or LVI, no metastasis, systemic treatment planned (type undecided). ER/PR, HER2, and menopause status will not alter treatment options.

Treatment	Rating	Comments
Principles of Treatment (Volumes)		
Chest wall RT	1	
Supraclavicular fossa/level III axilla RT	1	
Supraclavicular fossa and level I-III axilla RT	1	
Internal mammary node RT	1	
Central chest wall boost	1	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Note: Abbreviations used in the table are listed at the end of the "Major Recommendations" field.

Variant 6: 40-year-old premenopausal woman with infiltrating ductal carcinoma, S/P modified radical mastectomy, 3.5 cm UOQ, positive deep margins (tumor at ink), 0/15 LNs (+). No blood vessel invasion or LVI, no metastasis, systemic treatment planned (type undecided).

Treatment	Rating	Comments
Principles of Treatment (Volumes)		
Chest wall RT	9	
Supraclavicular fossa/level III axilla RT	2	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		
axilla RT		

Treatment	Rating	Comments
Internal mammary node RT	2	
Central chest wall boost	9	
Chest Wall RT Doses		
50-50.4 Gy in 25-28 fractions	9	
37.5-42.5 Gy in 16 fractions	6	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Note: Abbreviations used in the table are listed at the end of the "Major Recommendations" field.

Variant 7: 50-year-old postmenopausal woman, infiltrating ductal carcinoma, S/P modified radical mastectomy, 6.5 cm UOQ, margins (-), 0/15 LNs (+), ER/PR (+), HER2 (-). No blood vessel invasion or LVI, no metastasis, systemic treatment planned (type undecided).

Treatment	Rating	Comments
Principles of Treatment (Volumes)		
Chest wall RT	7	Recommendation to treat is individualized and based on patient age, tumor grade, margin status and +/- LVI.
Supraclavicular fossa/level III axilla RT	5	
Supraclavicular fossa and level I-III axilla RT	1	
Internal mammary node RT	5	There may be circumstances where nodal radiation is appropriate, depending on optimal chest wall coverage relative to the primary tumor position.
Central chest wall boost	7	Boost may be appropriate, as indicated by risk of residual microscopic disease relative to the radiation dose achieved with comprehensive chest wall irradiation.
Chest Wall RT Doses		
50-50.4 Gy in 25-28 fractions	9	
37.5-42.5 Gy in 16 fractions	6	In selected cases may be appropriate.
Supraclavicular Fossa/Axillary RT Doses		
45-50.4 Gy in 25-28 fractions	9	
37.5-42.5 Gy in 16 fractions	3	
IMN Chain RT Doses (if treating)		
50-50.4 Gy in 25-28 fractions	9	
37.5-42.5 Gy in 16 fractions	3	
Chest Wall Boost RT Doses (if treating)		
10 Gy in 5 fractions	9	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Note: Abbreviations used in the table are listed at the end of the "Major Recommendations" field.

Variant 8: 50-year-old postmenopausal woman with clinical stage III (T3N1) infiltrating ductal carcinoma, ER/PR (-), HER2 (-); treated with neoadjuvant chemotherapy followed by mastectomy and sentinel lymph node biopsy. Final pathology demonstrates no residual tumor in the breast and 0/2 SLN. Margins (-), no LVI.

Treatment	Rating	Comments
Principles of Treatment (Volumes)		
Chest wall RT	8	
Supraclavicular fossa/level III axilla RT	7	
Supraclavicular fossa and level I-III axilla RT	7	
Internal mammary node RT	5	
Central chest wall boost	4	
Chest Wall RT Doses		
50-50.4 Gy in 25-28 fractions	9	
37.5-42.5 Gy in 16 fractions	3	
Supraclavicular Fossa/Axillary RT Doses		
45-50.4 Gy in 25-28 fractions	9	
37.5-42.5 Gy in 16 fractions	3	
IMN Chain RT Doses (if treating)		
50-50.4 Gy in 25-28 fractions	8	
37.5-42.5 Gy in 16 fractions	3	
Chest Wall Boost RT Doses (if treating)		
10 Gy in 5 fractions	8	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Note: Abbreviations used in the table are listed at the end of the "Major Recommendations" field.

Variant 9: 50-year-old postmenopausal woman with clinical stage IIB (T2N1) infiltrating ductal carcinoma, ER/PR (+), HER2 (+); Prechemotherapy FNA of axillary LN was positive. Treated with neoadjuvant chemotherapy followed by mastectomy and lymph node dissection. Final pathology demonstrates no residual tumor in the breast and 0/15 LN. Margins (-), no LVI.

Treatment	Rating	Comments
Principles of Treatment (Volumes)		
Chest wall RT	7	
Supraclavicular fossa/level III axilla RT	7	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		
axilla RT		

Treatment	Rating	Comments
Internal mammary node RT	4	
Central chest wall boost	4	
Chest Wall RT Doses		
50-50.4 Gy in 25-28 fractions	9	
37.5-42.5 Gy in 16 fractions	2	
Supraclavicular Fossa/Axillary RT Doses		
45-50.4 Gy in 25-28 fractions	9	
37.5-42.5 Gy in 16 fractions	3	
IMN Chain RT Doses (if treating)		
50 Gy in 25 fractions	8	
37.5-42.5 Gy in 16 fractions	3	
Chest Wall Boost RT Doses (if treating)		
10 Gy in 5 fractions	8	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Note: Abbreviations used in the table are listed at the end of the "Major Recommendations" field.

Variant 10: 45-year-old woman, with diffuse suspicious calcifications, positive for DCIS, S/P simple mastectomy, no invasive carcinoma, but diffuse high-grade comedo DCIS with a positive deep margin (tumor at ink). Sentinel node at the time of mastectomy was negative.

Treatment	Rating	Comments
Principles of Treatment (Volumes)		
Chest wall RT	7	Chest wall irradiation may be indicated, depending on tumor grade, histology and the patient's age.
Supraclavicular fossa/level III axilla RT	1	
Supraclavicular fossa and level I-III axilla RT	1	
Internal mammary node RT	1	
Central chest wall boost	7	Boost is considered appropriate if a decision to treat is made and site of margin can be identified at simulation by surgical clips.
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Note: Abbreviations used in the table are listed at the end of the "Major Recommendations" field.

Summary of Literature Review

This summary focuses on the role of postoperative radiation therapy in patients treated with modified radical mastectomy for invasive breast cancer, particularly in patients receiving systemic therapy.

Patterns of Locoregional Failure after Mastectomy Alone

Older randomized studies have demonstrated that in the absence of radiotherapy (RT), locoregional failure can occur in approximately 25% to 40% of node-positive patients, and up to 15% to 20% of node-negative patients, who do not receive systemic therapy. The most frequent site of locoregional recurrence (LRR) is the chest wall, followed by axillary and supraclavicular nodal regions. Clinical detection of internal mammary (IM) nodal recurrences is rare, as they are primarily detected by imaging.

The overall risk of LRR, including the chest wall and nodal sites, is influenced by tumor size, tumor grade, the presence or absence of lymphovascular space invasion, surgical margin status, involvement of the fascia or skin, the number of involved lymph nodes (LNs), and the percentage of nodal involvement (or nodal ratio).

Several reports confirm the interaction of these pathologic features, as well as patient age, as compounding factors that determine the risk of LRR. In some series, the presence of extracapsular nodal extension has not been associated with an increased risk of local-regional failure when the total number of LNs is taken into account. Axillary or supraclavicular recurrences are rare following removal of Level I and II LNs when they are negative or when there are only one to three positive LNs. However, such failures are more common in patients with four or more positive LNs. With the increasing understanding of the importance of biologic subtypes in breast cancer, retrospective data suggest that estrogen receptor (ER)/progesterone receptor (PR) negative and HER2-positive tumors have higher rates of LRR compared with receptor-positive or HER2-negative subtypes.

More recent trials have demonstrated that the addition of systemic therapy improves LRR rates, which has raised the question of whether RT in the setting of modern systemic therapy can further improve outcomes.

Locoregional Risk Reduction and Impact on Survival with Postmastectomy Radiotherapy

Multiple trials over the last several decades have demonstrated that adjuvant postmastectomy radiotherapy (PMRT) reduces the risk of LRR. However, prior to the publication of the relatively recent randomized trials from the British Columbia Cancer Agency and the Danish Breast Cancer Cooperative Group, the use of PMRT was thought to improve local control only, without a significant effect on survival. These large prospective randomized trials, initially published in 1997 and 1999 and subsequently updated in 2005 and 2006, were the first trials using modern radiation techniques to demonstrate not only an improvement in local recurrence with the use of PMRT, but also an improvement in survival.

In premenopausal patients, the Danish Trial 82b initially reported a statistically significant improvement in rates of local recurrence (32% vs 9%, $P<.0001$), disease-free survival (DFS) (34% vs 48%, $P<.001$), and overall survival (OS) (45% vs 54%, $P<.001$) in favor of chest wall and regional lymphatic irradiation plus cyclophosphamide, methotrexate, 5-fluorouracil (CMF) chemotherapy compared with CMF alone. This study included stage II and III patients and had a median follow-up of 10 years at the time of initial publication. Most of these patients had node-positive disease, but node-negative patients with tumors >5 cm and/or skin or pectoralis fascia involvement were also eligible. Multivariate analysis confirmed that irradiation after mastectomy was a statistically significant factor in improving DFS and OS rates. This finding was consistent regardless of tumor size, number of positive LNs, or tumor grade, and was upheld with longer follow-up.

The Canadian Trial also examined outcomes for node-positive premenopausal patients randomized to CMF alone versus CMF plus locoregional irradiation. Updated results at 20 years demonstrated statistically significant improvements in event-free survival (25% vs 38% $P=.009$), survival free of isolated local failure (74% vs 90%, $P=.002$), breast-cancer-free survival (30% vs 48%, $P=.001$), and OS (37% vs 47%, $P=.03$) with the use of PMRT. These results are similar to the findings reported by the Danish Trial 82b. This analysis was stratified by the number of positive LNs, and no difference in risk reduction with PMRT was identified between patients with one to three positive LNs and those with four or more positive LNs.

The value of PMRT in node-positive postmenopausal patients was prospectively evaluated in the Danish Trial 82c. The study design included randomization to tamoxifen for 1 year only versus tamoxifen plus chest wall and regional lymphatic irradiation after mastectomy. Ten-year analysis showed statistically significant improvement in local recurrence rate (35% vs 8%, $P<.001$), DFS rate (24% vs 36%, $P<.001$), and OS rate (36% vs 45%, $P=.03$). An updated publication from the Danish 82b and 82c trials showed continued benefit from PMRT at a median potential follow-up time of 18 years. The 18-year probability of any breast cancer event was 73% without RT and 59% with RT ($P<.001$, relative risk [RR] 0.68, 95% confidence interval [CI], 0.63 to 0.75). The 18-year probability of LRR, with or without distant metastases (DM), was 49% without RT and 14% with RT ($P<.001$, RR 0.23, 95% CI, 0.19 to 0.27). The 18-year probability of DM after LRR was 35% with no RT and 6% with RT ($P<.001$, 95% CI, 0.11 to 0.20). The 18-year probability of any DM was 64% without RT and 53% with RT ($P<.001$, RR 0.78, 95% CI, 0.71 to 0.86).

Furthermore, a subset analysis of the Danish 82b and 82c trials suggested that the survival benefit after PMRT was restricted to the more favorable biologic profiles (hormone receptor positive and HER2-negative), while those with the poorest prognostic biologic features (hormone receptor negative and HER2-positive) had no significant OS improvement after PMRT. Questions therefore remain as to whether biologic features, in addition to nodal status, should be considered when evaluating the role of PMRT and its impact on survival.

The impact of PMRT on local control and OS has been further supported by the results of the Early Breast Cancer Trialists' Collaborative Group (EBCTCG) meta-analysis of 78 prospective randomized clinical trials. In those trials investigating mastectomy with and without RT, the addition of PMRT provided similar proportional reductions in local recurrence regardless of patient age, tumor characteristics, use of systemic therapy, or treatment area, although the absolute risk reduction was larger in the higher-risk populations. The 5-year local recurrence risks in LN-negative patients with and without PMRT were 2% and 6%, respectively, with a 3.6% decrement in 15-year breast cancer mortality. In LN-positive patients, the 5-year local recurrence risks were 6% and 23%, respectively, which translated into a 5.4% benefit in 15-year breast cancer mortality.

This meta-analysis demonstrated the relationship between the absolute reduction in 5-year local recurrence risk and breast cancer mortality. In those trials where the absolute reduction in LRR was <10% (mean 1%), the 15-year breast cancer mortality rates was improved by only 1%. A 10% to 20% absolute risk reduction in LRR (mean 17%) corresponded to a 4.5% absolute reduction in 15-year breast cancer mortality. The greatest benefit in breast cancer mortality was identified in those with >20% absolute reduction in 5-year local recurrence risk. If PMRT reduced the 5-year local recurrence risk by 20%, the 15-year breast cancer mortality rate would be reduced by 5.2%, suggesting that the addition of PMRT would eliminate one breast cancer death at 15 years for every four local recurrences prevented. Therefore, the baseline risk of LRR is directly related not only to the magnitude of the LRR risk reduction after PMRT but also to the potential survival benefit (see Variant 1 and Variant 2 above).

Postmastectomy Radiotherapy for Intermediate-Risk Patients

After the initial publication of the Danish and Canadian studies, the benefit of PMRT was readily accepted for women at high risk of LRR. However, some uncertainty remained as to the role of PMRT in patients with one to three involved LNs or high-risk node-negative disease. This controversy is due in part to the discrepancy in local recurrence rates among patients with one to three positive LNs who did not receive PMRT in the Danish and Canadian trials compared to the U.S. cooperative group trials. The LRR rates in these patients were substantially higher in the Danish and Canadian trials (30%-33%) than those reported in the retrospective analyses of prospective chemotherapy trials by the Eastern Cooperative Oncology Group (ECOG) and National Surgical Adjuvant Breast and Bowel Project (NSABP) chemotherapy trials, which both reported 10-year LRR rates of 13%. Variations in the extent of axillary surgery may account for the higher LRR rates noted in the Danish and Canadian trials, where the median numbers of LNs removed were 7 and 11, respectively, compared to 15 and 16 in the ECOG and NSABP trials, respectively. With fewer LNs resected, the true number of involved LNs may be underestimated in those trials, leading to a potential underestimation of risk due to nodal involvement and an overestimation of PMRT benefit in the intermediate-risk population.

In an attempt to address this question, investigators from the Danish Breast Cancer Group reanalyzed their data to exclude patients who had fewer than eight LNs resected. In patients with one to three positive LNs, the 15-year locoregional failure rates with and without PMRT were 4% and 27% ($P<0.001$), respectively, compared to 10% and 51% ($P<0.001$) in patients with four or more involved LNs. The 15-year OS rates in patients with one to three positive LNs were 57% with PMRT and 48% without ($P=0.03$), compared to 21% and 12% ($P=0.03$) in patients with four or more positive LNs. Interestingly, the number of patients needed to treat to avoid a LRR or to avoid a death was similar between the two groups. The needed to treat to avoid a LRR was four in the group with four or more positive LNs and five in those with one to three positive LNs, while the needed to treat to avoid a death was 10 and 11, respectively. These results addressed initial criticism regarding the extent of axillary surgery and demonstrate that PMRT is as beneficial in patients with one to three involved LNs as it is in higher-risk patients.

Further contributing to the uncertainty of survival benefit of PMRT in patients at intermediate risk, an analysis of women with T1-2 LN-positive breast cancer from the National Cancer Institute (NCI) Surveillance, Epidemiology, and End Results (SEER) program demonstrated a 8% improvement in 10-year OS for patients with seven or more positive LNs but was not associated with reduced mortality in patients with one to six positive LNs.

Given the ongoing controversy regarding PMRT in patients with one to three positive LNs or high-risk LN-negative disease, several retrospective studies have identified factors other than the number of involved LNs that may be associated with a higher risk of LRR after mastectomy alone. Such factors include young age, premenopausal status, tumor size, tumor grade, lymphovascular invasion (LVI), margin status, nodal ratio (number of positive LNs/total LNs resected), ER status, tumor subtype, 21-gene recurrence score, and the genomic predictive index. When more than one of these adverse risk factors is present in the setting of nodal involvement, more aggressive locoregional management may be warranted.

Additional prospective data evaluating the role of PMRT in intermediate risk patients are expected from an ongoing study in the UK (Selective Use of Postoperative Radiotherapy after Mastectomy); however, it will be several years before the results are available. A phase III trial in North America, in which women with one to three positive LNs after mastectomy were randomized to PMRT versus observation, closed prematurely due to poor accrual (see Variant 3, Variant 4, Variant 5, and Variant 6 above).

Postmastectomy Radiotherapy for pT3N0

Only approximately 1% of breast cancer patients present with pathological stage T3N0 disease. With this presentation, failure in the chest wall along the surgical scar is the most common site of LRR, followed by supraclavicular failures and, rarely, IM or axillary failures.

An older prospective trial reported LRR in 5 of 13 pT3N0 patients (38%) not randomized to postoperative irradiation compared with none of 27 patients treated with postoperative irradiation ($P=.002$). Similarly, the prospective Danish 82b study included women with T3N0 tumors ($n=135$) and demonstrated a reduction in LRR with PMRT (17% vs 3%) as well as an improvement in 10-year actuarial OS in this subgroup (70% vs 82%). The prospective Danish 82c study in postmenopausal women ($n=132$) found a similar reduction in the 10-year risk of LRR (23% vs 6%); however, the 10-year OS rates were not significantly different (55% vs 56%). These results support consideration of treatment to the chest wall in patients with pT3N0 breast carcinoma.

Despite the prospective evidence in support of PMRT for patients with pT3N0 disease, more recent retrospective data has challenged its routine use in this group of patients. Although an older retrospective series reported results in accordance with previously published prospective data (LRR in three of five patients [60%] treated without PMRT as compared to LRR in three of 33 patients [9%] who received PMRT [$P=0.0003$]), a group of researchers analyzed 70 patients with pT3N0 disease and demonstrated a 5-year rate of LRR without PMRT of only 7.6%. Of note, patients with lymphovascular space invasion were at significantly higher risk of local-regional failure. An analysis of 330 pT3N0 patients selected from various NSABP studies similarly reported a low LRR rate, with a 10-year isolated locoregional failure rate of 7.1%. The median number of LNs removed in both of these studies was 16, and 56% and 74% of patients, respectively, received systemic therapy. Another study reported a 10-year and 15-year rate of local recurrence of 12% and 13% in 101 patients with T3N0 breast cancer treated with mastectomy without PMRT. A study from the British Columbia Cancer Agency reported a 10-year cumulative LRR rate of 8.9% in 56 LN-negative patients with tumors ≥ 5 cm treated with mastectomy without PMRT compared to 2.3% in the 44 patients who received PMRT ($P=.02$). All six patients who recurred had grade 3 tumors and had not received systemic therapy. The curves for breast-cancer-specific survival diverged over time between the PMRT and no-PMRT cohorts; however, this difference was not statistically significant.

Finally, a group of authors reported an analysis of the NCI SEER database consisting of 1,777 patients with pT3N0 disease treated with mastectomy, 32% of whom received PMRT. In this analysis, PMRT was not a significant predictor of OS or cause-specific survival. Due to limitations of the SEER database, analysis of LRR rates was not possible.

Given the conflicting prospective and retrospective data, treatment of pT3N0 patients should continue to be highly individualized, taking into consideration the extent of nodal dissection, the use of systemic therapy, the pathologic margin status, the presence of LVI, and the biologic subtype (see Variant 7 above).

Postmastectomy Radiotherapy following Neoadjuvant Chemotherapy

The NSABP B-18 trial and a meta-analysis of nine randomized trials found no differences in DFS or OS when systemic therapy was given in the neoadjuvant or adjuvant setting. The parameters suggesting the need for PMRT may be different, however, with neoadjuvant therapies compared to adjuvant therapies. As there are no randomized data evaluating the role of PMRT after neoadjuvant chemotherapy, the best available data to assess its benefit are from retrospective studies of prospective neoadjuvant chemotherapy trials.

The M.D. Anderson Cancer Center has compared LRR rates after mastectomy without RT in patients treated with neoadjuvant ($n=150$) or adjuvant ($n=1031$) chemotherapy. The analysis was made from pooled findings of prospective trials involving patients with clinical stage IIIB disease treated with doxorubicin-based therapy. The 5-year actuarial LRR was 27% in the neoadjuvant group versus 15% in the adjuvant group ($P=.001$), representing primarily the imbalance in disease stage between the two groups. Both the initial clinical extent of disease and the pathologic residual disease were found to be important predictors of LRR. The authors concluded that PMRT should be offered to patients with four or more positive LNs, pathologic tumor >5 cm, or clinical stage III disease regardless of whether they receive neoadjuvant or adjuvant chemotherapy. In a further analysis of the 150 patients treated with neoadjuvant chemotherapy, an additional risk factor associated with LRR was no tamoxifen use. For patients with clinical stage II disease treated with neoadjuvant chemotherapy without irradiation, clinical and pathologic features associated with LRR include clinical T3N0 disease, four or more positive LNs after chemotherapy, age <40 years at diagnosis, and no use of tamoxifen with ER-positive disease.

After identifying those patients at risk for LRR after mastectomy in the setting of neoadjuvant chemotherapy, the investigators at M.D. Anderson evaluated outcomes in patients treated with and without PMRT. All patients received doxorubicin-based chemotherapy and a standard axillary dissection, with a median of 15 LNs removed. RT was delivered to the chest wall, supraclavicular, and IM areas, with inclusion of the axilla if insufficient numbers of axillary LNs were sampled. Ten-year LRR rates were 11% with PMRT versus 22% without ($P=.0001$). PMRT statistically significantly reduced LRR rates in patients with clinical T3 or T4 tumors, clinical N2-3, $pT >2$ cm, and four or more positive LNs. In addition, cause-specific survival was significantly improved with PMRT in patients who had clinical stage \geq IIIB, clinical T4 or N2/N3 disease, and four or more positive residual LNs. Upon multivariate analysis no radiation, $\geq 20\%$ nodal ratio, stage \geq IIIB, no tamoxifen, ER-negative tumors, or minimal response to chemotherapy were associated with higher rates of LRR. Additional studies found that those patients presenting with clinical T3N0 disease or patients <35 years of age had high rates of LRR after neoadjuvant chemotherapy and mastectomy if RT was omitted.

Another area of uncertainty is the role of PMRT in patients who achieve a pathologic complete response (pCR) after chemotherapy. An additional analysis by the M.D. Anderson group evaluated 106 patients who achieved a pCR (72 received PMRT and 34 did not). The 10-year LRR rates in stage III patients with and without PMRT were 7.3% and 33.3% ($P=.04$). The use of PMRT was also associated with improved disease-specific and OS. Of the 30 clinical stage II patients, there were no local recurrences in either group, limiting any definitive conclusions about the potential benefit of PMRT in this subset of patients. In contrast, another group reported no differences in LRR or survival with or without PMRT in 134 patients with stage II-III breast cancer who achieved pathologically negative LNs after neoadjuvant chemotherapy. Additional data from the NSABP B-18/B-27 trials showed that patients with clinical stage II disease who have negative LNs after preoperative chemotherapy have an 8-year risk of LRR after mastectomy that is less than 10%.

In 2007, the NCI convened a multidisciplinary expert panel to discuss the locoregional management of breast cancer after neoadjuvant chemotherapy. Based on the limited prospective data and the retrospective data from primarily a single institution, the NCI conference report recommends PMRT after neoadjuvant chemotherapy for patients presenting with clinical stage III disease or those with positive LNs after neoadjuvant therapy. There are limited data to recommend the routine use of PMRT in patients with clinical stage II disease prior to neoadjuvant therapy who achieve a pCR (see Variant 8 and Variant 9 above).

Postmastectomy Radiotherapy for Ductal Carcinoma in Situ

There are no prospective randomized data evaluating the role of PMRT for patients undergoing mastectomy for ductal carcinoma in situ (DCIS). Retrospective data most commonly address the question of PMRT in the setting of close or positive surgical margins.

One study reported that PMRT may be of benefit for patients with very close (<3 mm) or positive margins, particularly in the setting of high-grade disease. Local recurrences in patients with >3 mm margins were rare. With a median follow-up of 49 months, 6 of 81 patients (7.4%) had LRRs. Chest wall recurrences were noted in 4 patients, with the remaining two patients having axillary recurrences. The recurrence rates in patients with close, very close, or positive surgical margins were 2%, 11%, and 33% respectively. Patients with high-grade lesions had an 11% LRR rate, whereas low- to intermediate-grade lesions had a 3% recurrence rate. In the subgroup of patients with very close or positive surgical margins who had high-grade disease, a recurrence rate of 24% was observed.

In contrast, other series report low risks of LRR such that PMRT may not be warranted. One study reported LR in two of 19 (10.5%) patients treated with skin-sparing mastectomy with margins ≤ 1 mm, yet the overall recurrence rate of 5.1% at a mean follow-up of 82.3 months was thought to be similar to that seen after conventional mastectomy, suggesting that skin-sparing mastectomy for DCIS does not necessarily lead to excessively high rates of local recurrence compared to conventional mastectomy if margins are negative. Similarly, another study reported a 1.7% risk of chest wall recurrence in 59 patients with DCIS treated with mastectomy alone with close (<5 mm) or positive margins with a median follow-up of 8 years, and 3.3% in the patients with high-grade DCIS. They conclude that even in patients with close margins, recurrences are low enough that PMRT may not be warranted, although reexcision is recommended if feasible.

In a review of 10 cases of patients with DCIS treated with mastectomy who subsequently developed a chest wall recurrence, a group of authors noted common features among the chest wall relapse cases: young patient age, multiquadrant disease, and the presence of residual normal breast tissue after the mastectomy. Outcome following salvage radiation for the chest wall recurrences was excellent, with 9 of the 10 patients alive without evidence of disease.

With these limited retrospective data, the use of PMRT for DCIS needs to be highly individualized, with consideration of age of the patient, extent of disease, amount of residual breast tissue, and margin status (see Variant 10 above).

Treatment Volumes, Techniques, Toxicity

Volumes

In the three randomized trials demonstrating a benefit in local control as well as OS with the use of PMRT, RT was delivered to the chest wall and surgical scar, as well as to the regional LNs, including the supraclavicular, infraclavicular, axillary and IM LNs. Based on these results, it is generally accepted that the entire chest wall and mastectomy scar should be included. However, there is much more controversy as to which nodal regions to include. For most LN-positive patients, the ipsilateral supraclavicular fossa is usually included in the treatment volume, with much more variation as to when the IM LNs are included. This variation arises in part due to the potential increase in toxicity with the addition of IM nodal irradiation, particularly for left-sided cancers, and the uncertain additional benefit of nodal irradiation to chest wall RT alone. In early 1996 the European Organization for Research and Treatment of Cancer (EORTC) began a trial (protocol 22922/10925) examining the value of IM and medial supraclavicular chain irradiation for patients with positive axillary LNs or central/medial tumors treated with either breast-conserving surgery or mastectomy. The results of this trial are still pending. Preliminary data from a French study, in which 1,334 women treated with mastectomy with positive LNs or central tumors were randomized to chest wall and supraclavicular irradiation with or without IM RT, demonstrated no difference in OS between the two treatment groups. The recently presented MA-20 National Cancer Institute of Canada clinical trial demonstrated an

improvement in DFS with the use of regional nodal irradiation, including IM LNs, in node-positive or high-risk node-negative patients treated with breast-conserving surgery followed by whole-breast RT. With approximately 85% of patients in this trial having one to three positive LNs, these results challenge what was otherwise thought to be a lower risk group than those with four or more involved LNs. A retrospective study from the Massachusetts General Hospital (MGH) demonstrated similar rates of LRR, DFS, and OS in patients with one to three positive LNs treated with chest wall RT only as compared to those treated with chest wall and nodal irradiation, suggesting that PMRT to the chest wall only may be appropriate for women with tumors <5 cm and one to three positive LNs. The results from the EORTC 22922/10925 trial as well as longer follow-up of the MA-20 trial will help further elucidate the role of nodal irradiation in addition to chest wall RT in node-positive and high-risk node-negative patients.

Techniques

For patients receiving PMRT, the use of a computed tomography (CT) simulator and 3-dimensional treatment planning is preferable in order to allow visualization of the target and normal tissues. Given the variability of target and normal structure delineation for breast cancer, an expert panel developed a breast cancer contouring atlas for RT treatment planning.

Several techniques have been described to treat the chest wall after mastectomy, including tangential photon beams or en face electrons. The dose delivered to the chest wall is usually 50-50.4 Gy in 1.8-2 Gy fractions. The use of bolus is recommended to ensure that the dose to the skin is adequate. Occasionally a 10-16 Gy boost to the mastectomy scar is added, particularly in patients with a positive margin.

When targeting the supraclavicular fossa and axillary apex, an oblique anterior-posterior field is matched to the chest wall fields. CT-based treatment planning is important as the depth of the supraclavicular and level III LNs can vary based on patient anatomy. The exact depth can be determined from the CT and may influence the photon energy necessary or whether an anterior-posterior or posterior-anterior field may need to be considered. The dose to the supraclavicular/axillary apical field is usually 45-50.4 Gy in 25-28 fractions.

When targeting the IM LNs, CT simulation is helpful for visualizing the IM vessels. A separate electron field or a combination of low-energy photons and electrons can be used to treat the first three intercostal spaces. Another technique described is the use of partially wide tangential fields with blocking of the heart and inferior lung. Deep tangents may be considered; however, excessive dose to the lung and heart should be avoided. Doses of 45-50 Gy in 1.8-2 Gy fractions are usually used.

Institutions in Europe and Canada have often used hypofractionated schedules for breast cancer treatment. Most of the experience has been with whole-breast RT after breast-conserving surgery. However, 15% and 8% of the patients enrolled in the UK Standardisation of Breast Radiotherapy (START) trials A and B, respectively, were treated with mastectomy. Only 14% and 7% of all the patients received regional nodal treatment. The START A and B trials have reported acceptable late tissue effects and tumor control with treatment schedules of 13-15 fractions at 250-320 cGy per fraction. In the British Columbia randomized trial 37.5 Gy was delivered in 16 fractions to the chest wall, while the supraclavicular/axillary field received 35 Gy in 16 fractions. Although hypofractionated treatment has been used in these trials in the postmastectomy setting, the risk of potential additional toxicity, particularly to the brachial plexus and the lymphatics, should be considered.

Toxicity

The EBCTCG meta-analysis demonstrated that the addition of PMRT improved breast-cancer-specific survival at the cost of increased risks of contralateral breast cancer (1.18, $P=.02$) and non-breast-cancer-related deaths (1.12, $P=.001$). Most non-breast-cancer deaths were attributed to cardiac causes and, to a lesser extent, lung cancer. Both of these results were seen at 5 years and continued to be evident at the 15-year analysis.

An analysis using SEER data found that the cardiac mortality ratio for patients treated with PMRT for left ventricle versus right-sided has improved over time, with 10-year cardiac mortality ratios of 1.2, 1.04, and 0.96 for patients treated between 1973-1982, 1983-1992, and 1993-2001, respectively. This is likely a reflection of the use of more modern treatment techniques, and it emphasizes the importance of 3-dimensional treatment planning to minimize dose to the left ventricle and left anterior descending coronary artery, particularly with the use of cardiotoxic systemic agents such as anthracyclines and trastuzumab. The mortality ratio for lung cancer increased with longer follow-up, so long-term follow-up of patients treated with modern techniques will still be important, particularly in smokers.

The addition of a supraclavicular field increases the risk of lymphedema. The frequency of edema varies according to the extent of lymph node resection and body mass index. Conventional fractionation may be preferred to minimize risk of lymphedema as well as brachial plexopathy.

Summary

- PMRT is recommended for patients with T3N1, T4N1, and T4N2 primary tumors as well as T1-2 disease with 4 or more positive LNs.
- Some controversy remains regarding the benefit of PMRT in patients with T1-2 disease and with one to three positive LNs.
- Patients with pT3N0 tumors may benefit from PMRT in terms of locoregional control, though there are conflicting data regarding its impact

on survival.

- Patients undergoing neoadjuvant chemotherapy followed by mastectomy should receive PMRT if they present with clinical stage III disease or have residual nodal involvement.
- There are limited data supporting the routine use of PMRT in patients presenting with clinical stage II disease who achieve a pCR after neoadjuvant chemotherapy.
- The role of IM irradiation in addition to the chest wall and supraclavicular/axillary apex region is unclear, and long-term results from several trials will be important in defining which patients should receive treatment to the IM LNs. Treatment should be considered for patients at risk of IM involvement, such as those with medial or centrally located tumors and positive axillary LNs.
- Three-dimensional treatment planning is important to minimize dose to the lung and heart, particularly the left ventricle and left-anterior descending artery, in order to assure that improvements in breast-cancer-specific survival are not offset by non-breast-cancer mortality.

Abbreviations

- DCIS, ductal carcinoma in situ
- ER, estrogen receptor
- FNA, fine needle aspiration
- IMN, internal mammary (lymph) node
- LN, lymph node
- LVI, lymphovascular invasion
- PR, progesterone receptor
- RT, radiation therapy
- S/P, status post
- UOQ, upper outer quadrant

Clinical Algorithm(s)

Algorithms were not developed from criteria guidelines.

Scope

Disease/Condition(s)

Invasive breast cancer

Guideline Category

Risk Assessment

Treatment

Clinical Specialty

Internal Medicine

Obstetrics and Gynecology

Oncology

Radiation Oncology

Radiology

Surgery

Intended Users

Health Plans

Hospitals

Managed Care Organizations

Physicians

Utilization Management

Guideline Objective(s)

To evaluate the appropriateness of postmastectomy radiotherapy for patients with invasive breast cancer

Target Population

Patients with invasive breast cancer who have undergone modified radical mastectomy, particularly those receiving systemic therapy

Interventions and Practices Considered

1. Postmastectomy radiotherapy
 - Chest wall
 - Supraclavicular fossa and level III axilla
 - Supraclavicular fossa and level I&II axilla
 - Internal mammary node
 - Central chest wall boost
2. Radiotherapy dose

Major Outcomes Considered

- Local-regional failure and recurrence rates
- Disease-free survival
- Overall survival
- Long-term mortality from heart disease and lung cancer
- 18-year probability of any breast cancer event, local recurrence, or distant metastases
- Absolute reduction in 5-year local recurrence risk

Methodology

Methods Used to Collect/Select the Evidence

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Literature Search Procedure

The Medline literature search is based on keywords provided by the topic author. The two general classes of keywords are those related to the condition (e.g., ankle pain, fever) and those that describe the diagnostic or therapeutic intervention of interest (e.g., mammography, MRI).

The search terms and parameters are manipulated to produce the most relevant, current evidence to address the American College of Radiology Appropriateness Criteria (ACR AC) topic being reviewed or developed. Combining the clinical conditions and diagnostic modalities or therapeutic procedures narrows the search to be relevant to the topic. Exploding the term "diagnostic imaging" captures relevant results for diagnostic topics.

The following criteria/limits are used in the searches.

1. Articles that have abstracts available and are concerned with humans.
2. Restrict the search to the year prior to the last topic update or in some cases the author of the topic may specify which year range to use in the search. For new topics, the year range is restricted to the last 5 years unless the topic author provides other instructions.
3. May restrict the search to Adults only or Pediatrics only.
4. Articles consisting of only summaries or case reports are often excluded from final results.

The search strategy may be revised to improve the output as needed.

Number of Source Documents

The total number of source documents identified as the result of the literature search is not known.

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Strength of Evidence Key

Category 1 - The conclusions of the study are valid and strongly supported by study design, analysis and results.

Category 2 - The conclusions of the study are likely valid, but study design does not permit certainty.

Category 3 - The conclusions of the study may be valid but the evidence supporting the conclusions is inconclusive or equivocal.

Category 4 - The conclusions of the study may not be valid because the evidence may not be reliable given the study design or analysis.

Methods Used to Analyze the Evidence

Review of Published Meta-Analyses

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

The topic author drafts or revises the narrative text summarizing the evidence found in the literature. American College of Radiology (ACR) staff draft an evidence table based on the analysis of the selected literature. These tables rate the strength of the evidence for all articles included in the narrative text.

The expert panel reviews the narrative text, evidence table, and the supporting literature for each of the topic-variant combinations and assigns an appropriateness rating for each procedure listed in the table. Each individual panel member forms his/her own opinion based on his/her interpretation of the available evidence.

More information about the evidence table development process can be found in the ACR Appropriateness Criteria® Evidence Table Development document (see the "Availability of Companion Documents" field).

Methods Used to Formulate the Recommendations

Description of Methods Used to Formulate the Recommendations

Modified Delphi Technique

The appropriateness ratings for each of the procedures included in the Appropriateness Criteria topics are determined using a modified Delphi methodology. A series of surveys are conducted to elicit each panelist's expert interpretation of the evidence, based on the available data, regarding the appropriateness of an imaging or therapeutic procedure for a specific clinical scenario. American College of Radiology (ACR) staff distributes surveys to the panelists along with the evidence table and narrative. Each panelist interprets the available evidence and rates each procedure. The surveys are completed by panelists without consulting other panelists. The ratings are a scale between 1 and 9, which is further divided into three categories: 1, 2, or 3 is defined as "usually not appropriate"; 4, 5, or 6 is defined as "may be appropriate"; and 7, 8, or 9 is defined as "usually appropriate." Each panel member assigns one rating for each procedure per survey round. The surveys are collected and the results are tabulated, de-identified and redistributed after each round. A maximum of three rounds are conducted. The modified Delphi technique enables each panelist to express individual interpretations of the evidence and his or her expert opinion without excessive bias from fellow panelists in a simple, standardized and economical process.

Consensus among the panel members must be achieved to determine the final rating for each procedure. Consensus is defined as eighty percent (80%) agreement within a rating category. The final rating is determined by the median of all the ratings once consensus has been reached. Up to three rating rounds are conducted to achieve consensus.

If consensus is not reached, the panel is convened by conference call. The strengths and weaknesses of each imaging procedure that has not reached consensus are discussed and a final rating is proposed. If the panelists on the call agree, the rating is accepted as the panel's consensus. The document is circulated to all the panelists to make the final determination. If consensus cannot be reached on the call or when the document is circulated, "No consensus" appears in the rating column and the reasons for this decision are added to the comment sections.

Rating Scheme for the Strength of the Recommendations

Not applicable

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

Internal Peer Review

Description of Method of Guideline Validation

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The recommendations are based on analysis of the current literature and expert panel consensus.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Appropriate use of postmastectomy radiation therapy in patients with invasive breast cancer

Potential Harms

- A meta-analysis found that the addition of postmastectomy radiotherapy (PMRT) increased the risk of contralateral breast cancer (1.18, $p=.02$) and increased the risk of non-breast-cancer related deaths (1.12, $p=.001$). Most non-breast-cancer deaths were attributed to cardiac causes and to a lesser extent to lung cancer. Both of these results were seen at 5 years and continued to be evident at the 15-year analysis.
- The mortality ratio for lung cancer increased with longer follow-up, so long-term follow-up of patients treated with modern techniques will still be important, particularly in smokers.
- The addition of a supraclavicular field increases the risk of lymphedema. The frequency of edema varies according to the extent of lymph node resection and body mass index. Conventional fractionation may be preferred to minimize risk of lymphedema as well as brachial plexopathy.

Qualifying Statements

Qualifying Statements

The American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Living with Illness

IOM Domain

Effectiveness

Identifying Information and Availability

Bibliographic Source(s)

Horst KC, Haffty BG, Harris EE, Bailey L, Bellon JR, Carey L, Freedman GM, Goyal S, Halyard MY, MacDonald SM, Moran MS, Suh WW, Expert Panel on Radiation Oncology - Breast. ACR Appropriateness Criteria® postmastectomy radiotherapy. [online publication]. Reston (VA): American College of Radiology (ACR); 2012. 15 p. [68 references]

Adaptation

Not applicable: The guideline was not adapted from another source.

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American College of Radiology - Medical Specialty Society

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The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

Guideline Committee

Committee on Appropriateness Criteria, Expert Panel on Radiation Oncology–Breast

Composition of Group That Authored the Guideline

Panel Members: Kathleen C. Horst, MD (*Principal Author*); Bruce G. Haffty, MD (*Panel Chair*); Eleanor E. R. Harris, MD (*Panel Vice-chair*); Lisa Bailey, MD; Jennifer R. Bellon, MD; Lisa Carey, MD; Gary M. Freedman, MD; Sharad Goyal, MD; Michele Y. Halyard, MD; Shannon M. MacDonald, MD; Meena S. Moran, MD; W. Warren Suh, MD

Financial Disclosures/Conflicts of Interest

Not stated

Guideline Status

This is the current release of the guideline.

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Guideline Availability

Electronic copies: Available from the [American College of Radiology \(ACR\) Web site](#) .

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

Availability of Companion Documents

The following are available:

- ACR Appropriateness Criteria®. Overview. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in Portable Document Format (PDF) from the [American College of Radiology \(ACR\) Web site](#) .
- ACR Appropriateness Criteria®. Literature search process. Reston (VA): American College of Radiology; 1 p. Electronic copies: Available in PDF from the [ACR Web site](#) .
- ACR Appropriateness Criteria®. Evidence table development – diagnostic studies. Reston (VA): American College of Radiology; 2013 Nov. 3 p. Electronic copies: Available in PDF from the [ACR Web site](#) .
- ACR Appropriateness Criteria®. Evidence table development – therapeutic studies. Reston (VA): American College of Radiology; 2013 Nov. 4 p. Electronic copies: Available in PDF from the [ACR Web site](#) .
- ACR Appropriateness Criteria® postmastectomy radiotherapy. Evidence table. Reston (VA): American College of Radiology; 41 p. Electronic copies: Available from the [ACR Web site](#) .

Patient Resources

None available

NGC Status

This NGC summary was completed by ECRI Institute on September 10, 2009. This NGC summary was updated by ECRI Institute on September 19, 2012.

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